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(54) **Locking mechanism for locking a well tool in a well conduit.**

(57) The invention relates to a locking mechanism for locking a well tool in a well conduit (10). The locking mechanism comprises keys (13) which are radially movable relative to the axis (14) of the tool (12) and which emerge via apertures (18) made in the tool body in order to engage in the groove (11) of an anchor seat (10) interposed in the conduit. Each key (13) is also axially movable within the aperture (18) between a high position and a low position, and means (19, 15a) are provided for retaining the keys (13) in a high and radially retracted position. Key release requires the keys to be pushed inwardly over a suitable distance and then displaced downwardly.

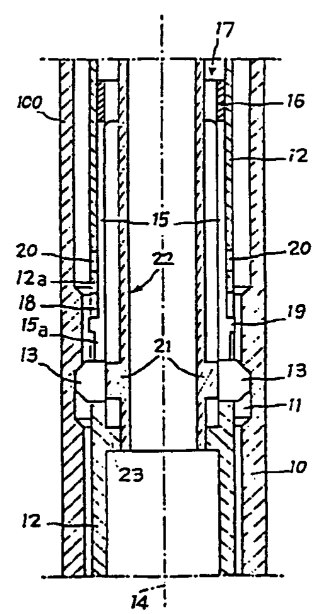

Fig-2

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Description

LOCKING MECHANISM FOR LOCKING A WELL TOOL IN A WELL CONDUIT

The present invention relates to a locking mechanism for locking a well tool in a well conduit, e.g. the production tubing of a hydrocarbon well, the locking mechanism comprising keys which are radially movable relative to the axis of the tool, and which are capable of emerging from the body of the tool, and which are capable of emerging from the body of the tool via apertures to engage in a groove in an anchoring seat interposed in the well conduit, said seat having an inside diameter which is smaller than the general diameter of the well conduit.

The aim of the invention is to obtain a locking mechanism of this kind which is simple in structure and easy to operate and which enables a tool to be locked in all types of anchor seat (a top stop seat, a bottom stop seat, or a selective seat), with locking being obtainable only in a seat of sufficiently small diameter and with it being possible to choose from the various anchor seats of appropriate diameter that may be included in any given conduit.

According to the invention each key is subjected to a resilient force which urges it away from the axis of the tool, and is also axially movable in the aperture via which it emerges between a high position and a low position, means being provided for holding the keys in the high and radially retracted position, which means are designed in such a manner that releasing the keys from said retaining means requires at least some of the keys to be pushed in beyond a well-defined more retracted position, followed by an axial displacement of the keys towards their low position, and in addition each key is associated with a moving abutment for locking the key radially in the locking position, i.e. in the low position and at a distance from the axis under the effect of said resilient force.

Thus, a tool can be locked in an anchor seat only after its keys have been released, and this requires the anchor seat to have a diameter suitable for causing the keys to be pushed a suitable distance towards the axis of the tool, and an upwards motion to be applied to the tool after its keys have come below the groove of said seat in order to bring the keys into the lower position where they are fully released and can then penetrate into said groove in order to be locked therein.

Preferably, the keys are interconnected so that they necessarily move together in translation along the direction of the axis of the tool.

In a preferred embodiment, said retaining means comprise respective abutment elements fixed to the keys, which elements bear against the wall of the tool body above said apertures when said keys are in their high position, thereby maintaining the keys in the retracted position, and that at least some of the abutment elements include a short stud directed radially outwardly from the tool, said stud retaining the corresponding key in the retracted and high position when engaged in a suitable orifice provided in the wall of the tool body, and being capable of being dislodged therefrom to release said key by the key being pushed in radially and then axially displaced towards its low position.

It is advantageous for the abutment elements and the stud associated with a key to be sufficiently close thereto for the corresponding aperture to receive the abutment elements and the stud when said key is released and takes up its low position.

In accordance with another characteristic of the invention, the abutment for radially locking each key is capable of taking up, by axial displacement, a preliminary locking position in which it partially overlaps the area of the corresponding aperture in the vicinity of the bottom edge thereof so as to provide partial backing against said abutment for the key when the key is in the low position, and a final locking position in which the key is fully backed against said abutment.

Advantageously, the radial locking abutments are carried on a moving sleeve disposed coaxially inside the body of the tool. They may then either interconnect to form a continuous ring or else they may be distinct, each having a circumferential extent which is less than the gap between the keys. In the first case, the tool is unlocked by causing said sleeve to move downwardly so that the continuous ring is brought below the keys; in the second case unlocking is obtained by rotating the sleeve about the axis until the keys come opposite the gaps between the abutments.

In an advantageous embodiment, the keys are carried by resilient fingers extending along the axial direction and belonging to a single part which is displaceable along said direction. It is then possible for the resilient fingers carrying the keys to be narrower than the keys and that each abutment for radial locking has a central notch running parallel to the axis and suitable for receiving the resilient finger of the corresponding key, but not the key itself. Unlocking is then obtained by moving the sleeve carrying the abutments so that, on leaving the keys, the abutments come opposite the key-carrying fingers, with the abutments being able to radially lock the keys but not the key-carrying fingers. This motion of the sleeve is upwardly directed when the keys are to be found at the bottom ends of the fingers.

In general, several pairs of keys are provided, regularly spaced in a ring around the body of the tool.

Other characteristics and advantages of the invention appear more clearly from the following description of an embodiment given by way of non-limiting example and described with reference to the accompanying drawings.

Figure 1 is a diagrammatic vertical section through a well having a conduit provided with anchor seats for a tool.

Figure 2 is a longitudinal section through the portion of the tool including locking mechanism in accordance with the invention.

Figure 3 is a perspective view of a one-piece

part including the keys of the Figure 2 mechanism.

Figures 4A to 4C are perspective views of the Figure 3 part together with an abutment sleeve in various different relative positions.

Figures 5A to 5E are diagrams in longitudinal section (with only the left sides being shown) of the locking mechanism in various stages of its operation.

Figures 6A to 6G show in a manner similar to Figures 5A to 5E those components of the tool which control locking, unlocking and then retraction of the keys.

Figure 1 shows a well which is drilled into an oil producing zone and which includes well conduit 100 inside casing 71. An annular sealing fitting or packer 63 is disposed between the bottom end of the conduit 100 and the casing 71. A tool 70 may be lowered down the conduit 100 by means of a cable 76 from which it is suspended. The cable emerges from the top of the conduit 100 via sealing means 72 and then passes via sheaves 73 and 74 and is wound onto the drum of a winch 75 disposed on the surface of the ground.

The tool 70 may be positioned temporarily in any one of several anchor seats 10 provided in the conduit 100 (by way of example two anchor seats 10 are shown, but in practice there may be any number of them). Each anchor seat is constituted by a length of tube incorporated in the conduit and providing a smaller inside diameter than the inside diameter of the conduit. A peripheral groove 11 is formed in the wall of the small diameter length and is suitable for receiving the moving keys 13 as they emerge radially from the tubular body 12 of the tool 70. When the tool is to leave the anchor seat in which it has been fixed, the keys 13 are retracted into the body of the tool.

In the following description of the locking mechanism for locking the tool 70, it is assumed that the tool is in its normal operating position in a vertical well.

As shown in Figures 2 and 3, the locking mechanism for locking the tool 70 comprises a plurality of pairs of diametrically opposite keys 13 which are regularly distributed in a ring centered on the common axis 14 of the tool body 12 and of the conduit 100. Each of these keys 13 is carried by a finger 15 extending parallel to the axis 14, but nevertheless resiliently deformable so as to enable the keys 13 to move radially relative to the axis 14. These fingers 15 have their top ends attached to a common annular base 16 so that the set of items 13, 15, and 16 constitute a single part 17.

The part 17 is engaged in the tubular body 12 of the tool and is capable of sliding longitudinally therein in the direction of the axis 14. The keys 13 emerge to the outside of the tubular body 12 via apertures 18 which extend further along the axis 14 than do the keys 13 so as to enable the part 17 to slide axially along a short stroke. The keys 13 can thus take up a high position in abutment against the top edges of the apertures 18 (Figures 5A and 5B) or else a low position in the bottom portions thereof (Figure 2).

Above the key 13, each finger 15 has a small stud 19 (Figures 2 to 4) projecting radially outwardly like the key 13 (however, it would be possible for only some of the fingers 15 to be provided with a stud 19, e.g. every other finger). When the key 13 is in its high position, the stud engages in an orifice 20 of suitable size made through the wall of the tubular body 12 above the corresponding aperture 18. While the studs 19 are engaged in the orifices 20, the part 17 is fixed and its keys 13 are in the high position in the apertures 18 and are retracted towards the axis 14 by virtue of the shape give to the portions 15a of the fingers 15 which are situated between the studs 19 and the keys 13 and which constitute abutment elements which are then pressed against the portions 12a of the tubular body 12 extending between the apertures 18 and the corresponding orifices 20 (Figure 5A). In contrast, when a stud 19 is moved out from its orifice 20 by one of the keys 13 being pushed radially inwardly, and when the key is in its low position in its aperture 18, then the key may move radially away from the axis 14 under the action of the resilient force generated by its finger 15 seeking to take up its natural position and thereby become engaged in the groove 11 of an anchor seat 10 in which it is locked by an abutment 21 belonging to a sleeve 22 placed coaxially inside the part 17 and movable in translation along the axis 14.

The structure and the operation of the abutments 21 is explained with reference to Figures 4A to 4C. The set of abutments 21 constitutes a ring projecting from the periphery of the sleeve 22, and this ring is interrupted by notches 23 level with the keys 13. The width e of these notches is less than the width t of the keys 13 but is greater than the width d of the fingers 15 (these are "circumferential" widths, i.e. widths measured as circles centered on the axis 14). Figure 4A shows the abutments 21 partially engaged behind the keys 13 and thus already preventing the keys from moving towards the axis 14. By applying an upward translation movement to the sleeve 22, the abutments 21 are moved so that they support the keys 13 over their entire axial height h which is substantially equal to the height of the keys 13 (Figures 2 and 4B). A complementary translation stroke moves the abutments 21 to above the keys 13. The keys are no longer supported and if they are pushed towards the axis 14 they are capable of retracting radially into the body of the tool 12 with the fingers 15 engaging in the notches 23 as they deform elastically (Figure 4C). Naturally, means are provided for guiding the sleeve 22 to prevent it from rotating about the axis 14 so as to keep the notches 23 facing the fingers 15.

In a variant, the keys 13 could also be unlocked by displacing the sleeve 22 downwardly so as to bring the abutments 21 fully beneath the keys 13, in which case the abutments could be connected in a continuous ring since the notches 23 would be pointless. In another variant, the notches 23 would be of width e greater than the width t of the keys 13 and they would be disposed at the same pitch as the keys. It would then be possible to rotate the sleeve 22 to bring the notches 23 level with the keys 13 which would then escape from the abutments 21. In this case, the means for guiding the sleeve 22 would

have to enable it to rotate through a limited angle about the axis 14.

The operation of the locking mechanism is now described with reference to Figures 5A to 5E. These figures show: the body 12 of a tool which has been lowered down the conduit 100 to be temporarily fixed to an anchor seat 10; the part 17 whose elastically deformable fingers 15 carry the keys 13 which emerge from the body 12 via the apertures 18; and the moving sleeve 22 including the abutments 21 for locking the keys 13. During the tool-lowering stage shown in Figure 5A, the keys 13 are held in their high position in the apertures 18 by the studs 19 being engaged in the orifices 20. In this situation, the keys 13 are retracted into the body of the tool 12 since the portions 15a of the fingers 15 are in abutment behind the corresponding portions 12a of the body 12, thereby leaving the keys to emerge slightly but not enough to come into contact with the inside surface of the conduit 100. The resilient fingers of the parts 17 are stressed and at a slight slope towards the axis 14. It may also be observed that the abutments 21 of the sleeve 22 are resting on an annular rim 24 projecting inwardly from the tubular body 12, with the rim 24 being positioned in such a manner that the abutments 21 are level, in part with the bottoms of the apertures 18.

The descent of the tool is stopped when the keys 13 have gone past the groove 11 of the anchor seat 10 (Figure 5B). The keys are then level with the reduced diameter portion of the seat 10 situated beneath the groove 11. This diameter is such that the keys 13 are pushed towards the axis 14 with the fingers 15 bending a little more so that the studs 19 move out from their orifices 20. It should be pointed out that the keys will operate in the same manner even so the keys have past below the anchor seat.

The tool can then be raised, leaving the keys 13 initially stationary by virtue of friction against the inside surface of the seat 10, after which the keys also rise by being lifted by the abutments 21 of the sleeve 22 which is pushed upwardly by the inside rim 24 of the tool body 12 (Figure 5C).

When the keys 13 come level with the groove 11 they engage in the groove by moving away from the axis 14 under the elastic spring force of the fingers 15. They thus escape from the upwards thrust of the abutments 21 and therefore remain stationary until they are again driven upwardly by the bottom edges of the apertures 18, meanwhile the top portions of the abutments 21 have moved radially behind the keys 13 thus beginning to lock them in the deployed anchoring position (Figure 5D). This deployment of the keys 13 is not hindered by the studs 19 since the apertures 18 are made tall enough to be able to receive the studs 19.

Tool locking operations are completed by a small upward translation movement applied to the sleeve 22 so as to bring the abutments 21 fully behind the keys 13, thereby firmly locking the keys in the groove 11 of the anchor seat 10 (Figure 5E).

When it is subsequently desired to release the tool from the anchor seat in which it has been locked in this way, a new upward translation movement is applied to the sleeve 22 in order to bring the abutments 21 above the keys 13 (Figure 4C). The tool can then be moved at will along the conduit 100 since the keys 13 are no longer locked by the abutment 21 and can therefore retract freely into the body of the tool 12 with the resilient fingers 15 on which they are carried being received by the notches 23 between the abutments 21.

Two observations may be made relating to the above-described locking mechanism :

1°/ It is suitable for locking the tool to which it is fitted only in an anchor seat of appropriate inside diameter. In particular, if the diameter of the seat encountered by the tool is too large, the keys are not pushed far enough into the body of the tool to remove the studs 19 from the orifices 20 in which they are engaged, and as a result the keys are not released and cannot be deployed in the groove of said anchor seat, regardless of the direction in which the tool is moving.

2°/ In order to lock the tool in an anchor seat 10 of appropriate diameter, the tool must be lowered so that the keys 13 are below the groove 11 (thereby releasing said keys), and must then be raised a little (thereby causing the keys to be deployed and then locked in said groove). Locking will not occur without this short rising stroke. As a result, while the tool is being lowered down to the locking seat in which it is to be locked, it may pass through any number of locking seats in which it could be locked, but which it is merely required to pass through.

The method by which the above-mentioned upwards translation movements of the sleeve 22 are obtained, initially for improving the locking of the keys 13 by the abutments 21 of the sleeve 22 and then at the end of operations for releasing said keys in order to unlock the tool, is now explained with reference to Figures 6A to 6G.

Figures 6C and 6D correspond to Figures 5D and 5E and similarly show the body 12 of the tool, and extended key 13, and the sleeve 22 which carries the abutments 21. The sleeve has a long tubular part 30 passing therethrough with the tool suspension cable 76 being fixed thereto. Between the part 30 and the body 12 there is an annular part 31 which is capable of sliding axially, as can the part 30. In the present example, this part 31 includes a valve 31a which co-operates with a seat (not shown). It also has a peripheral groove of rectangular section into which there projects an annular partition 12a of the body 12. A narrow sealed annular chamber 32 is disposed between the parts 30 and 31 and its volume varies as said parts slide axially relative to each other. This chamber is connected by a short radial duct 33 to a second sealed chamber 34 formed in the above-mentioned groove in the part 31 and delimited by the fixed partition 12a. The two chambers 32 and 34 and the duct 33 are filled with hydraulic fluid.

Between the valve 31a of the part 31 and the sleeve 22 there is a tubular member 35 suitable for communicating upward displacement of the part 31 to the sleeve 22.

Below the part 31, the part 30 is surrounded by a

part 36 similar to the part 17 and comprising a set of fingers 36b which are integral with an annular base 36a and which extend substantially parallel to the axis 14 with a tendency to move resiliently closer thereto. Each finger 36b is terminated by a key 36c which is suitable, when the finger is forced away from the axis 14, for coming into engagement with a groove 12b provided on the inside face of the body 12. It may be observed that the inside diameter of the body 12 below the groove 12b is smaller than the inside diameter above the groove, such that each key 36c is capable, when taking up an intermediate radial position as defined below, of escaping downwardly from said groove, but not upwardly.

The annular base 36a of the part 36 is engaged in a groove 30a provided on the outside of the part 30. This groove extends axially over a slightly greater distance than the thickness of the base 36a such that the part 36 is capable of moving a short distance axially relative to the part 30. It is urged upwardly by a compression spring 37 interposed between the base 36a and a collar 30b belonging to the part 30. As for the part 30, it is urged downwardly by a compression spring 38 interposed between a collar 30e on the part 30 above the groove 30a, and a collar 12c belonging to the body 12.

Each key 36c is capable of bearing via an axially directed tooth 36'c included thereon against a crenelated sleeve 39 including a series of annular catches 39a extending axially upwardly from an annular zone 39b whose outside diameter is slightly greater than the outermost diameter of the annular catches 39a, with the zone 39b being delimited downwardly by an annular shoulder 39'd constituted by a second annular zone 39d of even larger diameter. Beyond the second annular zone 39d, the sleeve 39 has a set of fingers 39c extending substantially parallel to the axis 14 and urged towards the axis by their elasticity. Each finger 39c terminates in a tooth 39'c engaged with one of a set of annular catches 30c disposed along the outer surface of the part 30. The teeth 39'c and the catches 30c are triangular in shape so that the sleeve 39 can slide downwardly over the part 30 with its teeth 39'c skipping from catch 30c to catch 30c but is not capable of sliding upwardly. As for the teeth 36'c and the catches 39'a, they are too triangular in shape such that the keys 39b are capable of moving upwardly relative to the sleeve 39 by jumping from catch 39a to catch 39a, but not of moving downwardly.

Initially (Figure 6A), the keys 36c of the part 36 are fully engaged in the groove 12b and are kept away from the axis by their teeth 36'c resting on the annular zone 39b of the sleeve 39, while the keys 39'c of the resilient fingers 39c are engaged in the top catch of the series of catches 30c of the part 30. The part 36 is thus fixed inside the body 12 of the tool with its base 36a being urged by the spring 37 into a high position in the groove 30a of the part 30, and with the spring 38 being in compression.

When traction is exerted on the cable 76 (Figure 6B) the part 30 is raised by a distance equal to the clearance allowed for the base 36a of the part 36 in the groove 30a (which clearance is equal to the pitch of the catches 30c and 39a and to the width of the zone 39b), thereby compressing the spring 37. Since the sleeve 39 cannot move upwardly, being retained by its shoulder 39'd coming into abutment against the tooth 36'c of each key 36c, its teeth 39'c skip into the second catch 30c.

When traction on the cable 76 then ceases (Figure 6C), the part 30 moves back downwardly by virtue of the springs 37 and 38 expanding, and moves initially through the above-mentioned distance together with the sleeve 39. As a result, the teeth 36'c of the part 36 leave the zone 39b and fall into the bottom catch 39a. The keys 36c then take up the above-mentioned intermediate position such that they are capable of leaving the groove 12b downwardly, thereby enabling the part 36 and consequently the part 30 to move further downwardly as the spring 38 expands (Figure 6D). As the part 30 moves downwardly the volume of the chamber 32 is increased and the volume of the chamber 34 is reduced by the same amount, thereby raising the part 31 whose valve 31a pushes the sleeve 22 by means of the tubular member 35 so that the abutments 21 move behind the keys 13. The tool is now securely locked in the conduit.

When traction is again applied to the cable 36, the part 30 is raised, thereby compressing the spring 38 which will cause the part 30 to move back down again when traction is released. In each of such traction and release cycles, the part 31 is actuated by the set of hydraulic chambers 32 and 34, together with the valve 31a. However, on each traction (figure 6E), the rising displacement of the part 30 is limited by the bottom edge of the groove 30a coming into abutment against the base 36a of the part 36 which is stopped in its upwards movement by its keys 36c coming into abutment against the top edge of the groove 12b, thereby causing the teeth 39'c of the sleeve 39 to skip one catch 30c downwardly. Then, when the cable 37 is released (Figure 6F), the previously compressed spring 38 expands, thereby lowering the part 30, the sleeve 39 and the part 36, and the spring 37 also expands, thereby causing the teeth 36c of the 36 to skip one catch 39a upwardly.

After a given number of traction and release cycles of the cable 36, the next release causes the teeth 36'c to escape from the top catch 39a of the part 39 (Figure 6G), so that the keys 36c move a little closer to the axis 14 and can then escape upwardly from the groove 12b. During the last traction operation, the stroke of the part 30 is thus no longer limited and its increased amplitude enables it to drive the sleeve 22 upwardly by any appropriate means such as the two collars 30d and 22a respectively fixed to the part 30 and to the sleeve 22, with the collar 30d raising said sleeve by means of its collar 22a. The keys 13 are then retracted towards the axis 14 (see Figure 4C) into the body 12 of the tool so that the tool is unlocked and may be raised up the conduit.

Claims

1. Locking mechanism for locking a well tool in a well conduit (100), said conduit being provided with an anchoring seat (10) which forms an internal restriction and includes a groove (11), said tool including a tubular body (12) provided with radial apertures (18), said locking mechanism comprising:

- a plurality of keys (13) capable of emerging from said body via said apertures to engage said groove, said keys being radially movable relative to the axis (14) of said body and also axially movable in its corresponding aperture between a high position and a low position;
- resilient means (15) for spreading said keys into engagement with said groove;
- retaining means for holding said keys in the high and radially retracted position, said keys being released when at least some of the keys are pushed in towards the axis of the body, followed by an axial displacement of the keys towards their low position ; and
- mobile abutment means (21) for radially locking said keys in engagement with said groove.

2. Locking mechanism according to claim 1, wherein said keys (13) are interconnected so that they necessarily move together in translation along the direction of the axis (14) of the tool.

3. Locking mechanism according to claim 1 or 2, wherein said retaining means comprise respective abutment elements (15a) fixed to the keys (13), which elements bear against the wall of the tool body above said apertures when said keys are in their high position, thereby holding the keys in the retracted position, and

at least some of the abutment elements include a short stud (19) directed radially outwardly from the tool, said stud retaining the corresponding key in the retracted and high position when engaged in a suitable orifice (20) provided in the wall of the tool body, and being capable of being dislodged therefrom to release said key by the key being pushed in radially and then axially displaced towards its low position.

4. Locking mechanism according to claim 3, wherein said abutment element (15a) and the stud associated with a key are sufficiently close thereto for the corresponding aperture to receive the abutment elements and the stud (19) when said key is released and takes up its low position.

5. Locking mechanism according to any one of claims 1 to 4, wherein said mobile abutment means (21) is capable of taking up, by axial displacement, a preliminary locking position in which it partially overlaps the area of the corresponding aperture (18) in the vicinity of the bottom edge thereof so as to provide partial backing against said abutment for the key when the key is in the low position, and a final locking position in which the key is fully backed against said abutment.

6. Locking mechanism according to any one of claims 1 to 5, wherein said mobile abutment means (21) are carried on a moving sleeve (22) disposed coaxially inside the body (12) of the tool.

7. Locking mechanism according to claim 6, wherein said mobile abutment means (21) are interconnected to form a continuous ring.

8. Locking mechanism according to claim 6, wherein said mobile abutment means (21) are separate and each extends circumferentially by an amount which is less than the gap between keys (13).

9. Locking mechanism according to any one of claims 2 to 8, wherein said keys (13) are carried by resilient fingers (15) extending along the axial direction and belonging to a single part which is displaceable along said direction.

10. Locking mechanism according to claim 9, wherein said resilient fingers (15) carrying the keys are narrower than the keys and that said mobile abutment means (21) has a central notch (23) running parallel to the axis (14) and suitable for receiving the resilient finger of the corresponding key, but not the key itself.

11. Locking mechanism according to any one of claims 1 to 10, wherein said keys (13) are regularly distributed around said tool body.

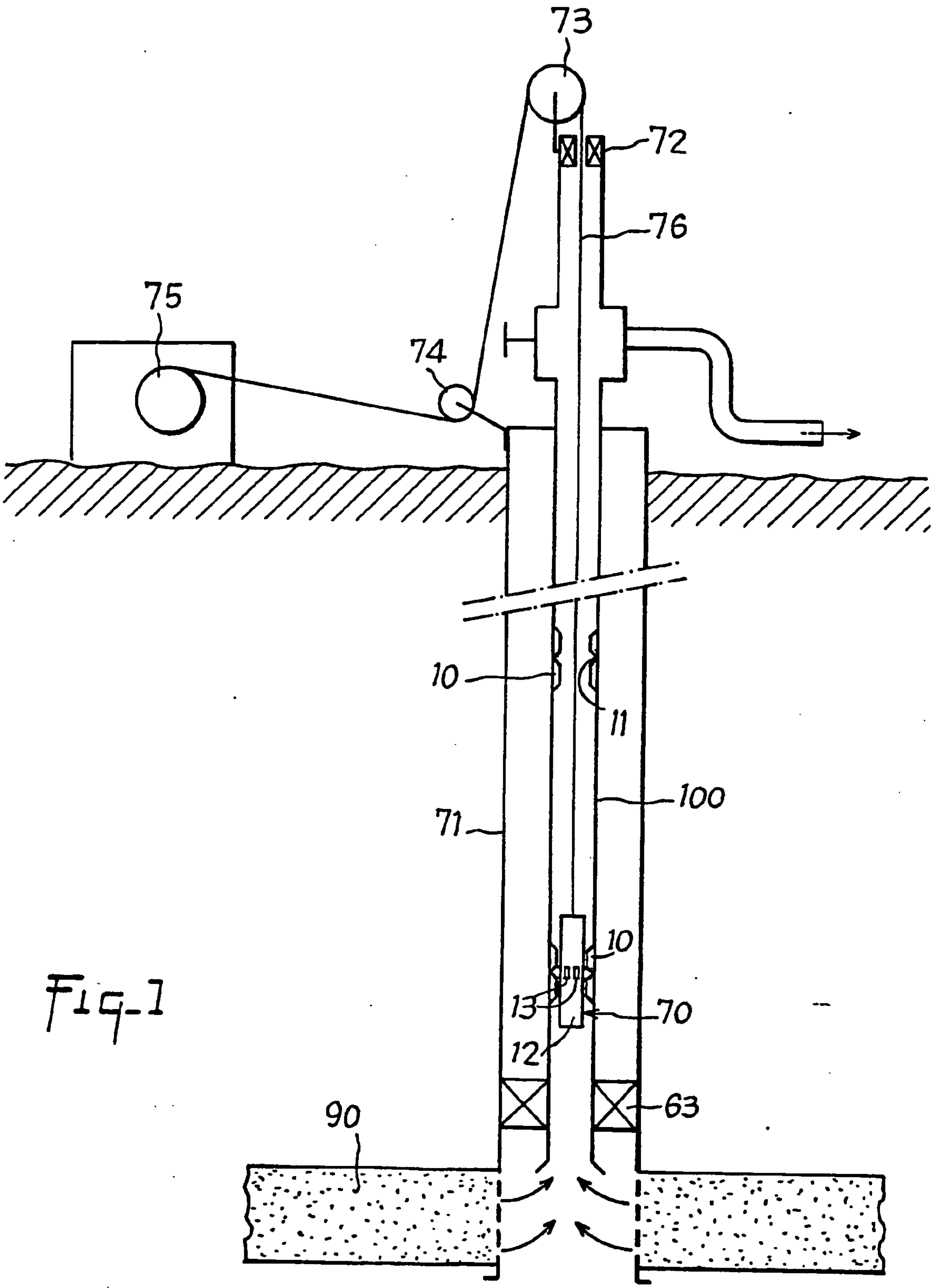

Fig.1

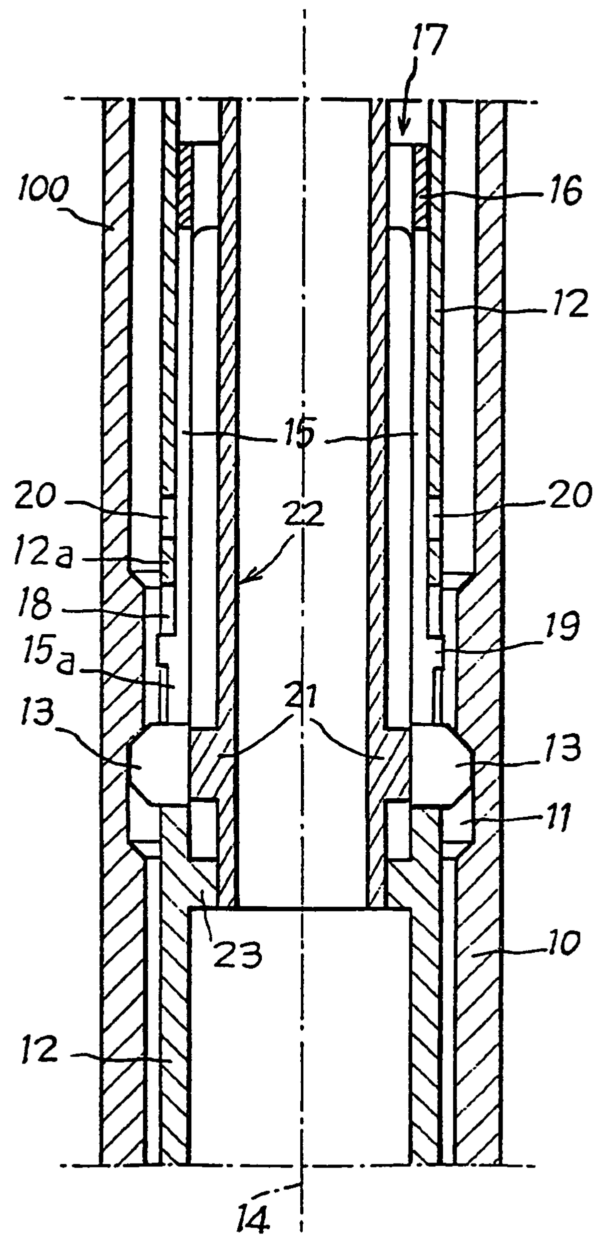
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Fig-2

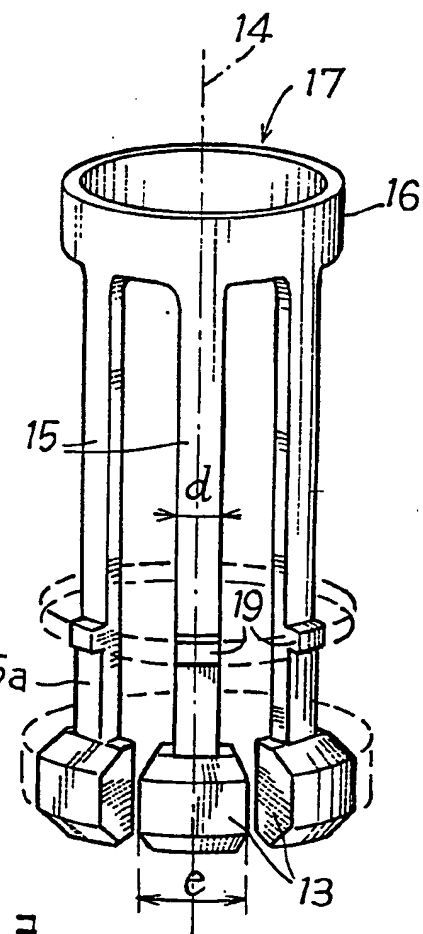
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Fig-3

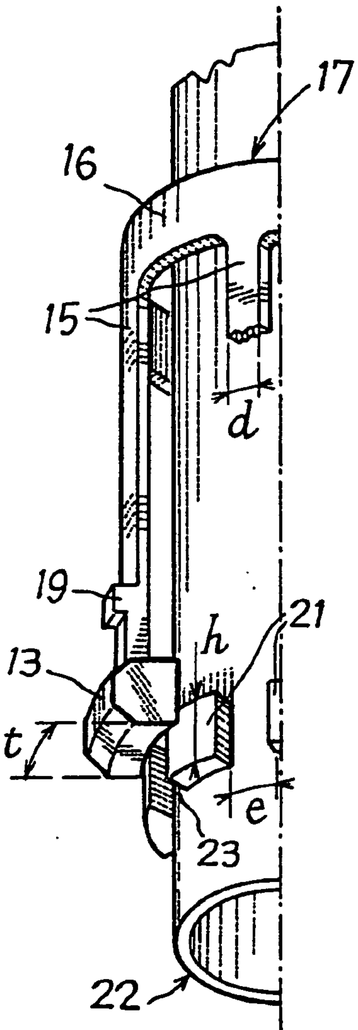

Fig-4A

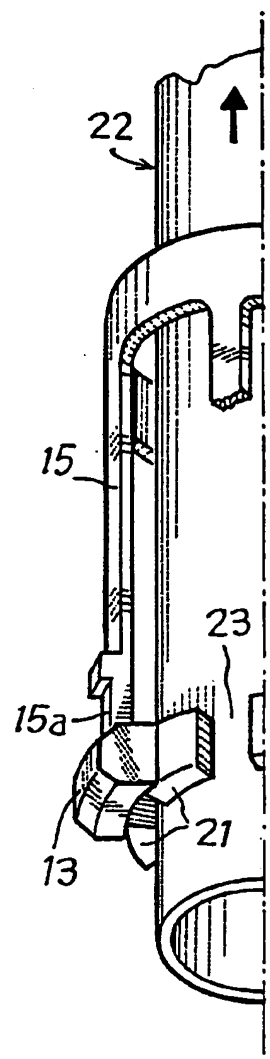

Fig-4B

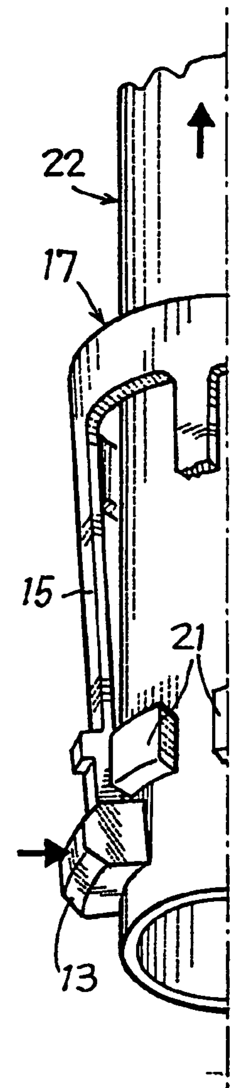

Fig-4C

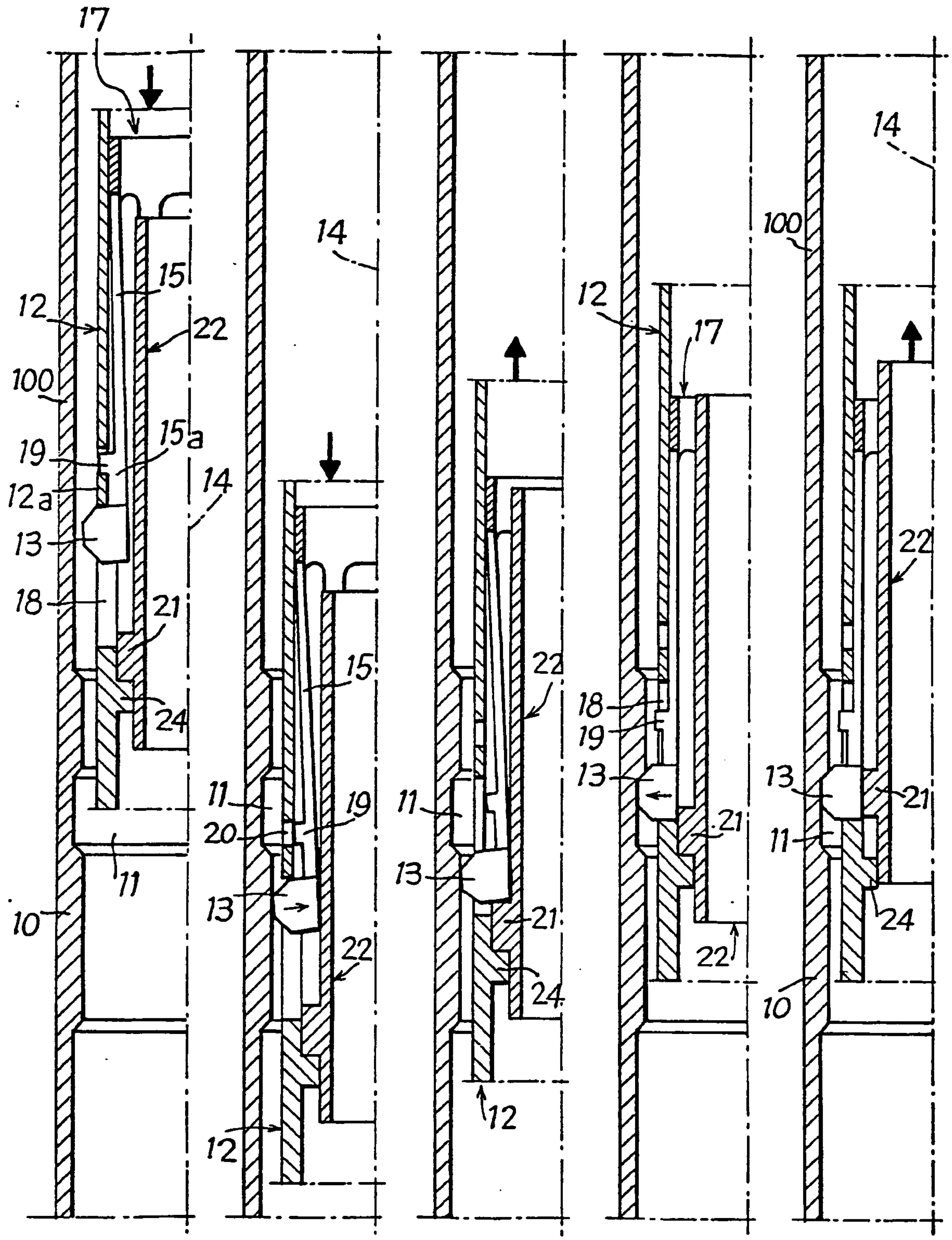

Fig_5A Fig_5B Fig_5C Fig_5D Fig_5E

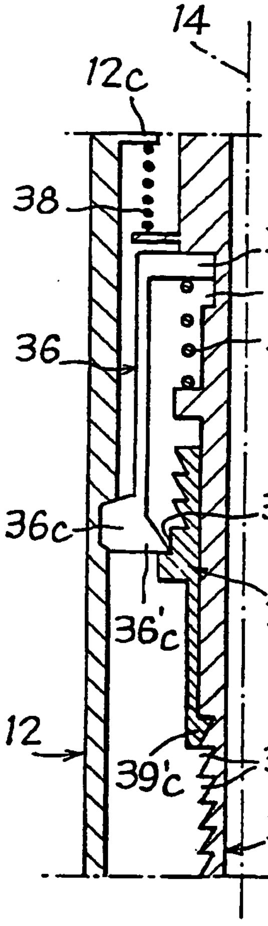

Fig-6A

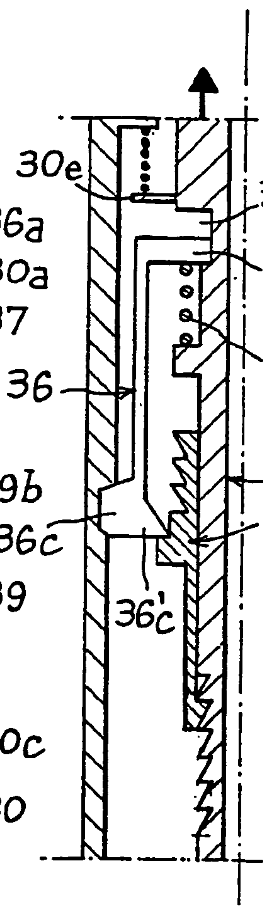

Fig-6B

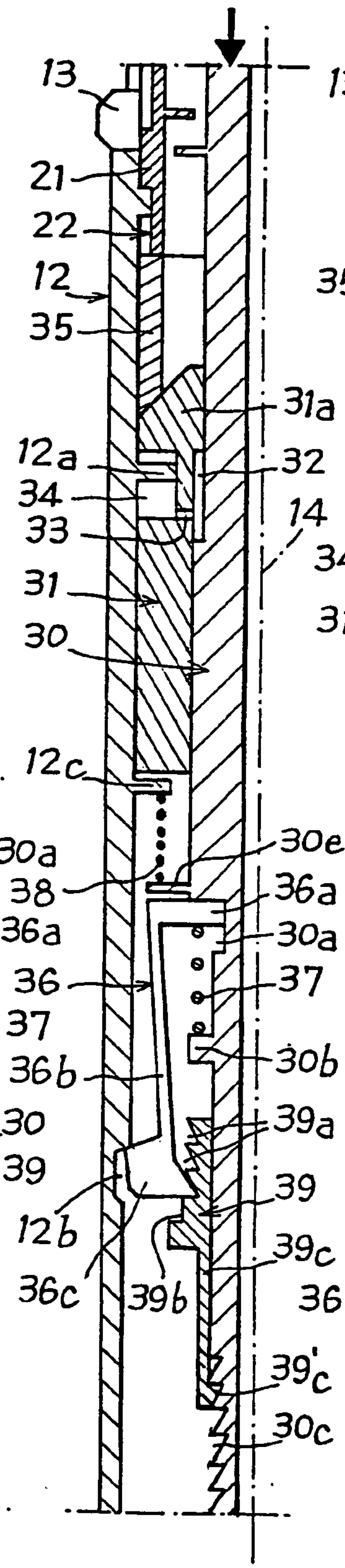

Fig-6C

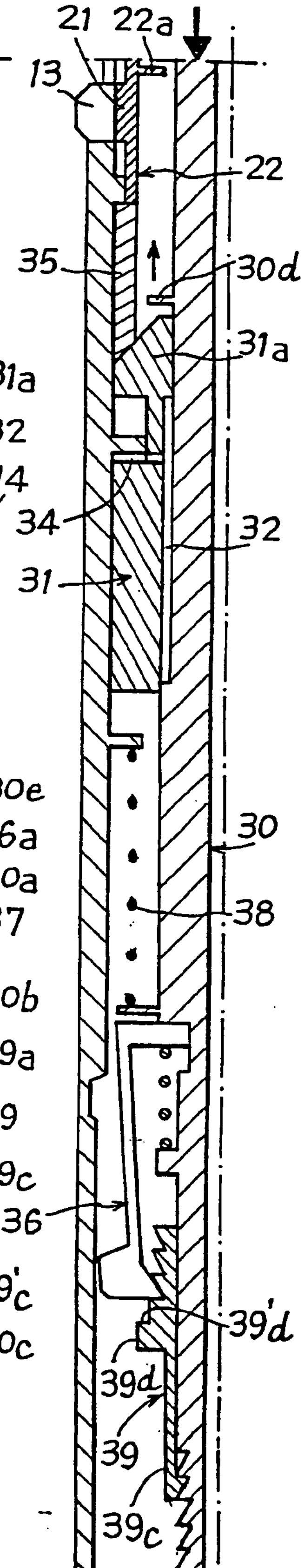

Fig-6D

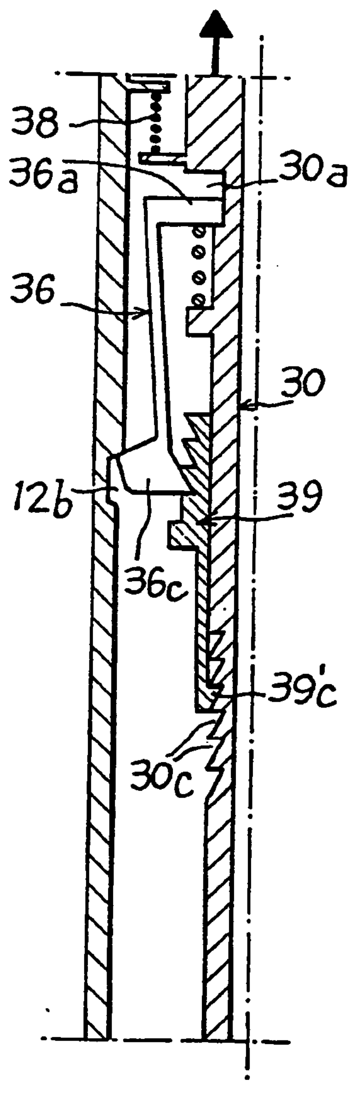

Fig-6E

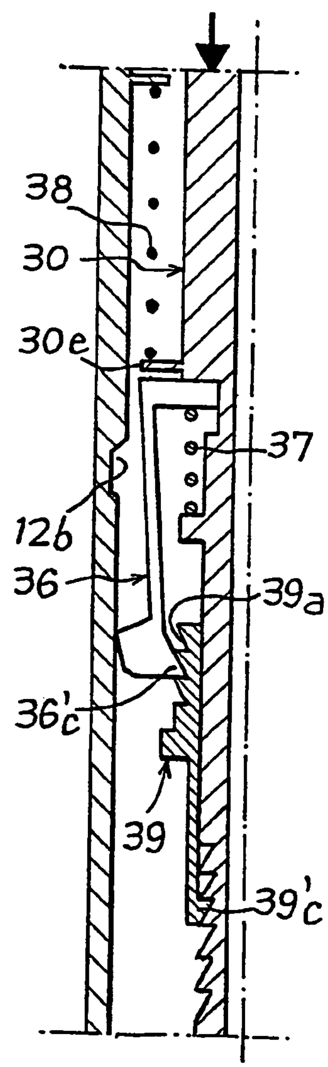

Fig-6F

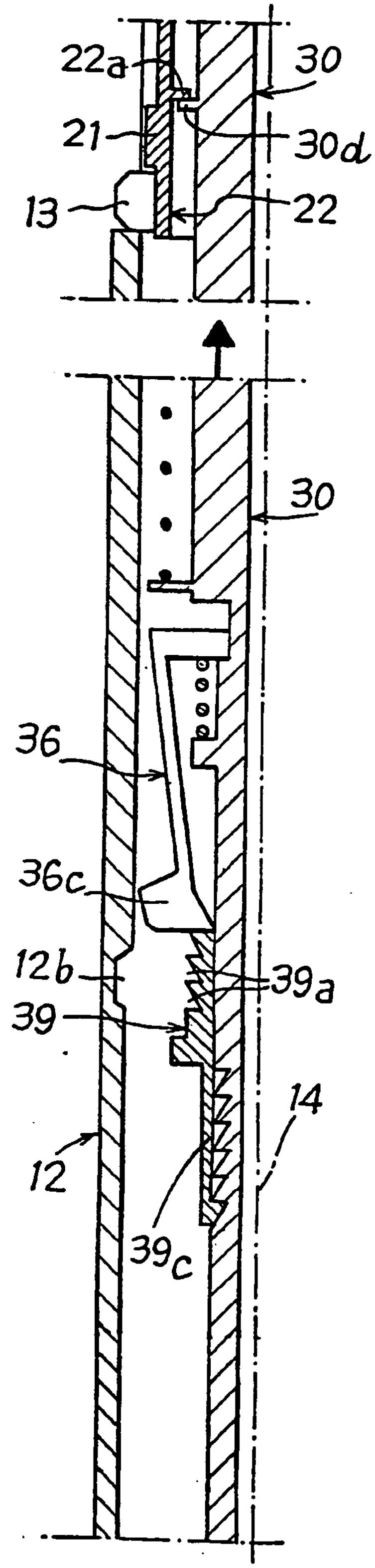

Fig-6G

European Patent Office

EUROPEAN SEARCH REPORT

Application Number

EP 88 40 1211

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.4)
A	US-A-4 362 211 (FISHER) * Figures; abstract; column 3, lines 59-68; column 4 *	1	E 21 B 23/02
A	US-A-4 554 972 (MERRITT) * Figures; column 3, lines 23-43; column 5, lines 53-68; column 6, lines 1-20 *	1	
A	US-A-2 605 843 (BAKER) * Figures; column 3, lines 44-65 *	1	
A	US-A-4 469 173 (GILBERT) * Figures; abstract *	1	
			TECHNICAL FIELDS SEARCHED (Int. Cl.4)
			E 21 B

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	25-07-1988	WEIAND T.

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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